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(54) **PRODUCING YARN**

GARNHERSTELLUNG

FABRICATION D'UN FIL

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Description

[0001] The present invention relates to processes for producing yarn, to yarns produced by the processes, to fabrics comprising the yarn and to transmission belts comprising such fabrics.

[0002] Existing transmission or timing belts, when used in engines or the like, are designed with teeth which mesh with appropriate pulleys to provide synchronised power transmission.

The transmission belts are formed by pressing a suitable resilient fabric over a mould to mould the teeth and impregnating the fabric with suitable elastomer. Distortion of the teeth during use leads to wear on the belt and is a mode of failure. Additionally, the distortion of the teeth leads to elastic hysteresis, which in turn leads to the build up of heat.

[0003] Nylon has usually been chosen as a fabric forming the surface of the belt which contacts the pulleys. Nylon has the advantage of resilience when textured, with good heat and wear resistance, under the temperatures and under the conditions in current engines. However, there is a need for yarns that can be used to form fabrics for transmission belts that are able to withstand higher temperatures and also with enhanced chemical stability because engines in the future are likely to run at higher temperatures to improve efficiency and may also have a more aggressive chemical environment. There is, in any case, a need for transmission belts that do not require replacement during the lifetime of an engine. Yarns contributing to these advantages would also have uses in many other technical fabrics.

[0004] There have been attempts to increase the heat or wear resistance of fabrics by incorporating other materials such as PTFE. WO-A-2003/031700 relates to a fabric that can be used in a timing or transmission belt that contains PTFE to reduce friction. In WO-A-2003/031700, a yarn is disclosed having an elastic core thread which is surrounded by a thread comprising a friction reducing substance, e.g. PTFE.

[0005] US-A-3,259,939 relates to formation and processing of textile fibres and filamentary materials.

[0006] US-A-3,822,543 relates to a non-twist high bulky yarn having a spun-like handle.

[0007] JP-A-04057933 relates to a woven fabric.

[0008] US-A-2006/177656 relates to fibre blends comprising at least one high performance fibre with one or more other fibres.

[0009] There have also been attempts to use heat and chemical wear resistant polymers such as aramid filaments in yarns. Unfortunately, aramid filaments alone have a very high modulus and so are not elastic enough to enable good forming on the mould or be acceptable in use as a transmission belt. A combination of aramid with nylon and elastomer has been attempted, but can introduce further problems because elastomers can degrade leaving voids in the transmission belt that possibly accelerate wear and reduce life. Use of texturised nylon and aramid filament leads to problems on activation (using methods such as scouring) because, after the yarn bulks, the aramid filament is forced out of the bundle causing loops. Loops cause disadvantages including reduced abrasion resistance and hence reduced durability, reduced consistency of the final product, reduction of the dynamic performance of the fabric especially in terms of stretch characteristics and a reduced or inconsistent adhesion performance.

[0010] The present invention aims to address these problems and provide a more heat resistant, wear and chemical resistant yarn for use in technical fabrics.

[0011] The present invention accordingly provides a process for the production of a yarn, the process comprising providing a bundle comprising continuous filaments of a thermoplastic polymer, contacting the bundle with a sliver comprising fibres of a heat resistant material combining the filaments and the sliver a drawing step to produce a new bundle and applying a gas jet to the new bundle to distribute the fibres of the heat resistant material in the mixed bundle, thereby distributing the fibres between and among the filaments.

[0012] The great advantage of the inventive process is that it enables a mixed bundle of filaments of a thermoplastic polymer together with fibre of a heat resistant material to be produced which overcomes problems associated with the differing properties of the thermoplastic polymer and the heat resistant material, especially after activation. Such a process also provides a great advantage in that the yarns produced by the invention, containing as they do both thermoplastic polymer and fibres of a heat resistant material, can have the advantages both of thermoplastic polymers and heat resistant materials as regards modulus, heat, wear and chemical resistance.

[0013] The heat resistant material is preferably selected from glass (e.g. glass fibre), carbon (e.g. carbon fibre) or a non-thermoplastic polymer fibre. The heat resistant material may be a combination of two or more of these material types.

[0014] When the heat resistant material is a non-thermoplastic polymer it is preferably selected from aramid, polyamide-imide, polyimide-amide, liquid crystal polymer, PVA, P84 (polyimide), PBI or PTFE. Of these, the preferred non-thermoplastic polymers are aramids (e.g. para-aramid such as Kevlar™, Twaron™, Technora™ or Zylon™ or meta-aramid such as Nomex™, Conex™ and Newstar™).

[0015] Aramids, whether para- or meta- are particularly advantageous because of their chemical, heat and wear resistance and exceptional strength.

[0016] The non-thermoplastic fibre (in particular aramid) is in staple (e.g. break-spun) form.

[0017] Preferably, the thermoplastic polymer is texturised. This provides advantages, especially after activation as regards elasticity (which as discussed above in the background to the present invention) is necessary both in use as a technical fabric (in particular a transmission belt) or in the preparation of articles (including trans-

mission belts) by a moulding process.

[0018] A great advantage of the present invention is that texturised thermoplastic polymers can be used in combination with heat resistant materials but, after activation, the heat resistant material will not be forced out of the bundle thereby avoiding formation of loops or loose fibres. Because the process involves the preparation of a mixed bundle from a sliver comprising fibres of the heat resistant material (preferably non-thermoplastic polymer such as aramid), after activation the fibres of the heat resistant material tend to overlap rather than being forced out of the yarn. This means that the beneficial properties deriving from the heat resistant material are retained in the yarn even after activation.

[0019] Activation is a process involving scouring (i.e. washing in water) and drying and results in bulking of the thermoplastic polymer, especially a texturised thermoplastic polymer. Preferably, the process further comprises at least one activation step.

[0020] The thermoplastic polymer may be selected from polyamide, polyester, PBT, poly ether ether ketone, poly ether imide or polyolefin (e.g. polyethylene or polypropylene). Of these thermoplastic polymers the currently preferred thermoplastic polymer is polyamide and in particular nylon (for example PA66, PA46 or PA6).

[0021] The bundle of filaments of thermoplastic polymer will be contacted with the sliver during a drawing step (usually on the drawing frame).

[0022] After the mixed bundle has been formed, preferably it undergoes at least one further step to produce the finished yarn. This is to improve the distribution of the heat resistant fibre in the final yarn.

[0023] In the process of the invention, the mixed bundle preferably comprises the fibres of the heat resistant material in an amount of between 5 and 75% by weight. Less than about 5% by weight will result in less of the beneficial properties of the heat resistant material being apparent in the bundle or the mixed yarn after spinning. At more than about 75% by weight, the benefits of the invention are likewise reduced.

[0024] Preferably the fibres of the heat resistant material are comprised in the mixed bundle in an amount above 10, 15, 20, 25 or 30% by weight. Preferably, the mixed bundle comprises the fibres of the heat resistant material in an amount of less than 70, 65, 60 or 55% by weight.

[0025] In the process of the present invention preferably the thermoplastic filaments are in the range of 33 to 2000 decitex, more preferably in the range of 60 to 1600 decitex.

[0026] The process of the present invention is advantageously performed with a fibre of heat resistant material of a length between 10 mm and 200 mm. If the fibres are significantly shorter than 10mm then the mixed bundle will not necessarily contain significant overlapping of the heat resistant fibres throughout. If fibres of the heat resistant material are significantly longer than 200 mm problems associated with the heat resistant material fibres being forced out of the mixed bundle or yarn can occur.

[0027] Preferably the length of fibres of the heat resistant material is above 20, 30, 40 or 45 mm. Preferably, the length of the fibres of the heat resistant material is below 180, 160, 150 or 140 mm.

[0028] In a second aspect, the present invention provides a yarn according to claim 13. Beneficial features of the second aspect of the invention are generally the same, with appropriate modification, as those discussed in relation to the first aspect.

[0029] Yarns produced by the process of the first aspect of the invention or according to this second aspect of the invention may be used to produce fabrics having the beneficial properties deriving from both the thermoplastic polymer and the heat resistant material. Such fabrics find uses in many areas where technical fabrics are used currently, one of the more important uses will be as a transmission belt comprising the fabric.

[0030] The present invention is illustrated by the following drawings in which:

Figure 1 illustrates schematically a comparative yarn before activation,

Figure 2 illustrates schematically the comparative yarn after activation,

Figure 3 illustrates the process of the present invention,

Figure 4 illustrates schematically the yarn according to the present invention before activation, and

Figure 5 illustrates the yarn according to the present invention after activation.

[0031] Figure 1 illustrates a comparative yarn 1, which consists of thermoplastic filaments 2 of Nylon 66, and heat resistant material filaments, of para aramid 4. Before activation the filaments of thermoplastic polymer 2 and heat resistant material 4 are well mixed in the yarn.

[0032] Figure 2 illustrates the comparative yarn 5 after activation (scouring in water and drying). The activation process shrinks and bulks the bundle of thermoplastic polymer filaments 2. However, the heat resistant material filaments 4 do not act in the same way as the thermoplastic filaments 2. Consequently, the heat resistant filaments 4 are forced out of the mixed yarn forming loops 6. Loops 6 cause disadvantages including reduced abrasion resistance and hence reduced durability, reduced consistency of the final product, reduction of the dynamic performance of the fabric especially in terms of stretch characteristics and a reduced or inconsistent adhesion performance.

[0033] Figure 3 illustrates the process according to the present invention in which a mixed bundle 8 is produced. The mixed bundle is formed of continuous filament 2 of a thermoplastic polymer, Nylon 66, and a sliver (a poorly cohesive bundle of generally coaxial staple fibres of relatively short length, between 10 and 200 mm of break-spun para aramid fibres). The bundle of thermoplastic

continuous filaments 2 and the sliver of para aramid fibres 10 are brought together in a drawing step on a drawing frame (not illustrated) before the step illustrated in Figure 3. After drawing, an unmixed, or poorly mixed, bundle 12 of the para aramid sliver (the fibres 10 of which are still mainly cohering) and the thermoplastic filaments 2 is produced. This unmixed bundle 12 is passed through a tube where a compressed gas jet 14 is applied to the unmixed bundle 12. The effect of the compressed gas jet is to separate the still partly formed sliver of para aramid fibres 10 and to distribute the para aramid fibres 10 in the bundle of thermoplastic filaments 2. The result is a mixed bundle of thermoplastic continuous filaments 2 and para aramid fibres 10 wherein the para aramid fibres are distributed much more evenly between and among the continuous thermoplastic filaments 2.

[0034] Figure 4 illustrates schematically the yarn produced by the process illustrated in Figure 3, after spinning but before yarn activation. The yarn comprises continuous filaments 2 of thermoplastic polymer and aramid fibres 10 distributed between and among the filaments 2.

[0035] Figure 5 illustrates the situation after activation of the yarn. Activation results in the bundle of the thermoplastic filaments 2 reducing significantly in length and bulking out. As a result of this the aramid fibres 10 come closer together with the result that they overlap in the yarn rather than being forced out into loops 6 as illustrated in Figure 2. A consequence of this is that the yarn retains beneficial properties of both the thermoplastic polymer and the aramid fibres even after activation.

Claims

1. A process for the production of a yarn, the process comprising

providing a bundle comprising continuous filaments of a thermoplastic polymer (2),
contacting the bundle with a sliver comprising fibres of a heat resistant material (10)

characterised in that the process further comprises:

combining the filaments (2) and the sliver (10) in a drawing step to produce a new bundle (12) and applying a gas jet (14) to the new bundle (12) to distribute the fibres of the heat resistant material (10) in the mixed bundle (8), thereby distributing the fibres (10) between and among the filaments (2).

2. A process as claimed in claim 1, wherein the heat resistant material (10) is selected from glass, carbon or a non-thermoplastic polymer.

3. A process as claimed in claim 2, wherein the non-thermoplastic polymer is selected from aramid, polyamide-imide, polyimide-amide, liquid crystal polymer, PVA, polyimides, PBI or PTFE.

4. A process as claimed in either claim 2 or claim 3, wherein the thermoplastic polymer (2) is a texturized thermoplastic polymer.

5. A process as claimed in any one of the preceding claims, further comprising at least a scouring step.

6. A process as claimed in any one of the preceding claims, wherein the thermoplastic polymer (2) is selected from polyamide, polyester, PBT, poly ether ether ketone, poly ether imide or polyolefin.

7. A process as claimed in any one of the preceding claims, wherein the new bundle (12) comprises the fibres of the heat resistant material (10) in an amount of between 5 and 75% by weight.

8. A process as claimed in any one of the preceding claims, wherein the filaments of thermoplastic (2) are in the range 33 to 2000 decitex.

9. A process as claimed in any one of the preceding claims, wherein the length of the fibres of the heat resistant material (10) is between 10 mm and 200 mm.

10. A process as claimed in any one of the preceding claims, wherein the drawing step is performed on a drawing frame.

11. A process comprising forming the yarn produced according to any one of the preceding claims into a fabric.

12. A process according to claim 11, further comprising using the fabric to produce a transmission belt.

13. A yarn comprising:

filaments of a thermoplastic polymer (2) in the range 33 to 2000 decitex; and
fibres of a heat resistant material (10) having a length between 10 mm and 200 mm,

characterised in that the fibres of heat resistant material (10) are aligned with and distributed between and among the filaments of thermoplastic polymer (2) and wherein the fibres of heat resistant material (10) align with and overlap one another.

14. A yarn as claimed in claim 13, wherein the heat resistant material (10) is selected from glass, carbon or a non-thermoplastic polymer.

15. A yarn as claimed in claim 14, wherein the non-thermoplastic polymer is selected from aramid, polyamide-imide, polyimide-amide, liquid crystal polymer, PVA, polyimides, PBI or PTFE.

16. A yarn as claimed in any one of claims 13 to 15, wherein the thermoplastic polymer filament (2) is a texturised thermoplastic polymers Filament.

17. A yarn as claimed in any one of claims 13 to 16, wherein the thermoplastic polymer (2) is selected from polyamide, polyester, PBT, poly ether ether ketone, poly ether imide or polyolefin.

18. A fabric comprising yarn as claimed in any one of claims 13 to 17.

19. A transmission belt comprising a fabric as claimed in claim 18.

Patentansprüche

1. Verfahren zur Herstellung eines Garns (8), das Verfahren umfassend:

das Bereitstellen eines Bündels, umfassend kontinuierliche Filamente eines thermoplastischen Polymers (2),
das Inkontaktbringen des Bündels mit einem Band, umfassend Fasern eines hitzebeständigen Materials (10),

dadurch gekennzeichnet, dass das Verfahren des Weiteren umfasst:

das Kombinieren der Filamente (2) und des Bandes (10) in einem Streckschritt, um ein neues Bündel (12) herzustellen, und das Anwenden eines Gasstrahls (14) auf das neue Bündel (12), um die Fasern des hitzebeständigen Materials (10) in dem gemischten Bündel (8) zu verteilen, wodurch die Fasern (10) zwischen und unter den Filamenten (2) verteilt werden.

2. Verfahren gemäß Anspruch 1, wobei das hitzebeständige Material (10) ausgewählt ist aus Glas, Kohlenstoff oder einem nicht-thermoplastischen Polymer.

3. Verfahren gemäß Anspruch 2, wobei das nicht-thermoplastische Polymer ausgewählt ist aus Aramid, Polyamid-Imid, Polyimid-Amid, Flüssigkristallpolymer, PVA, Polyimide, PBI oder PTFE.

4. Verfahren gemäß Anspruch 2 oder Anspruch 3, wobei das thermoplastische Polymer (2) ein texturiertes thermoplastisches Polymer ist.

5. Verfahren gemäß einem der vorherigen Ansprüche, des Weiteren umfassend mindestens einen Reinigungsschritt.

6. Verfahren gemäß einem der vorherigen Ansprüche, wobei das thermoplastische Polymer (2) ausgewählt ist aus Polyamid, Polyester, PBT, Polyetheretherketon, Polyetherimid oder Polyolefin.

7. Verfahren gemäß einem der vorherigen Ansprüche, wobei das neue Bündel (12) die Fasern des hitzebeständigen Materials (10) in einem Anteil von zwischen 5 und 75 Masseprozent umfasst.

8. Verfahren gemäß einem der vorherigen Ansprüche, wobei die Filamente des thermoplastischen Polymers (2) im Bereich von 33 bis 2000 Decitex liegen.

9. Verfahren gemäß einem der vorherigen Ansprüche, wobei die Länge der Fasern des hitzebeständigen Materials (10) zwischen 10 mm und 200 mm beträgt.

10. Verfahren gemäß einem der vorherigen Ansprüche, wobei der Streckschritt auf einem Streckwerk durchgeführt wird.

11. Verfahren, umfassend das Bilden des Garns, das gemäß einem der vorherigen Schritte hergestellt wurde, zu einem Gewebe.

12. Verfahren gemäß Anspruch 11, des Weiteren umfassend das Verwenden des Gewebes zum Herstellen eines Transmissionsriemens.

13. Garn (8), umfassend:

Filamente eines thermoplastischen Polymers (2) im Bereich von 33 bis 2000 Decitex; und
Fasern eines hitzebeständigen Materials (10) mit einer Länge zwischen 10 mm und 200 mm,

dadurch gekennzeichnet, dass die Fasern des hitzebeständigen Materials (10) ausgerichtet ist an und verteilt ist zwischen und unter den Filamenten des thermoplastischen Polymers (2) und wobei die Fasern des hitzebeständigen Materials (10) aneinander ausgerichtet sind und sich überlagern.

14. Garn gemäß Anspruch 13, wobei das hitzebeständige Material (10) ausgewählt ist aus Glas, Kohlenstoff oder einem nicht-thermoplastischen Polymer.

15. Garn gemäß Anspruch 14, wobei das nicht-thermoplastische Polymer ausgewählt ist aus Aramid, Polyamid-Imid, Polyimid-Amid, Flüssigkristallpolymer, PVA, Polyimide, PBI oder PTFE.

16. Garn gemäß einem der Ansprüche 13 bis 15, wobei

das thermoplastische Polymerfilament (2) ein texturiertes thermoplastisches Polymerfilament ist.

17. Garn gemäß einem der Ansprüche 13 bis 16, wobei das thermoplastische Polymer (2) ausgewählt ist aus Polyamid, Polyester, PBT, Polyetheretherketon, Polyetherimid oder Polyolefin.

18. Gewebe, umfassend ein Garn gemäß einem der Ansprüche 13 bis 17;

19. Transmissionsriemen, umfassend ein Gewebe gemäß Anspruch 18.

Revendications

1. Un procédé pour la production d'un fil (8), le procédé comprenant

fournir un paquet comprenant des filaments continus d'un polymère thermoplastique (2),
mettre en contact le paquet avec un ruban comprenant des fibres d'un matériau résistant à la chaleur (10)

caractérisé en ce que le procédé comprend en outre :

combiner les filaments (2) et le ruban (10) dans une étape d'étirage pour produire un nouveau paquet (12) et appliquer un jet de gaz (14) sur le nouveau paquet (12) afin de répartir les fibres du matériau résistant à la chaleur (10) dans le paquet mélangé (8), ce qui permet de répartir les fibres (10) entre et parmi les filaments (2).

2. Un procédé tel que revendiqué dans la revendication 1, où le matériau résistant à la chaleur (10) est choisi parmi le verre, le carbone ou un polymère non thermoplastique.

3. Un procédé tel que revendiqué dans la revendication 2, où le polymère non thermoplastique est choisi parmi l'aramide, le polyamide-imide, le polyimide-amide, un polymère de cristal liquide, le PVA, les polyimides, le PBI ou le PTFE.

4. Un procédé tel que revendiqué dans n'importe lesquelles de la revendication 2 ou de la revendication 3, où le polymère thermoplastique (2) est un polymère thermoplastique texturé.

5. Un procédé tel que revendiqué dans l'une quelconque des revendications précédentes, comprenant en outre au moins une étape de lavage.

6. Un procédé tel que revendiqué dans l'une quelconque des revendications précédentes, où le polymère thermoplastique (2) est choisi parmi le polyamide, le polyester, le PBT, le poly éther éther cétone, le poly éther imide ou une polyoléfine.

7. Un procédé tel que revendiqué dans l'une quelconque des revendications précédentes, où le nouveau paquet (12) comprend les fibres du matériau résistant à la chaleur (10) en une quantité comprise entre 5 et 75 % en poids.

8. Un procédé tel que revendiqué dans l'une quelconque des revendications précédentes, où les filaments de thermoplastique (2) titrent de 33 à 2 000 décitex.

9. Un procédé tel que revendiqué dans l'une quelconque des revendications précédentes, où la longueur des fibres du matériau résistant à la chaleur (10) est comprise entre 10 mm et 200 mm.

10. Un procédé tel que revendiqué dans l'une quelconque des revendications précédentes, où l'étape d'étirage est réalisée sur un banc d'étirage.

11. Un procédé comprenant la formation du fil produit selon l'une quelconque des revendications précédentes en un tissu.

12. Un procédé selon la revendication 11, comprenant en outre l'utilisation du tissu pour produire une courroie de transmission.

13. Un fil (8) comprenant :

des filaments d'un polymère thermoplastique (2) titrant de 33 à 2 000 décitex ; et
des fibres d'un matériau résistant à la chaleur (10) ayant une longueur comprise entre 10 mm et 200 mm,

caractérisé en ce que les fibres de matériau résistant à la chaleur (10) sont alignées avec et réparties entre et parmi les filaments de polymère thermoplastique (2) et où les fibres de matériau résistant à la chaleur (10) s'alignent les unes avec les autres et se chevauchent.

14. Un fil tel que revendiqué dans la revendication 13, où le matériau résistant à la chaleur (10) est choisi parmi le verre, le carbone ou un polymère non thermoplastique.

15. Un fil tel que revendiqué dans la revendication 14, où le polymère non thermoplastique est choisi parmi l'aramide, le polyamide-imide, le polyimide-amide, un polymère de cristal liquide, le PVA, les polyimides, le PBI ou le PTFE.

16. Un fil tel que revendiqué dans l'une quelconque des revendications 13 à 15, où le filament polymère thermoplastique (2) est un filament polymère thermoplastique texturé.

17. Un fil tel que revendiqué dans l'une quelconque des revendications 13 à 16, où le polymère thermoplastique (2) est choisi parmi le polyamide, le polyester, le PBT, le poly éther éther cétone, le poly éther imide ou une polyoléfine.

18. Un tissu comprenant du fil tel que revendiqué dans l'une quelconque des revendications 13 à 17.

19. Une courroie de transmission comprenant un tissu tel que revendiqué dans la revendication 18.

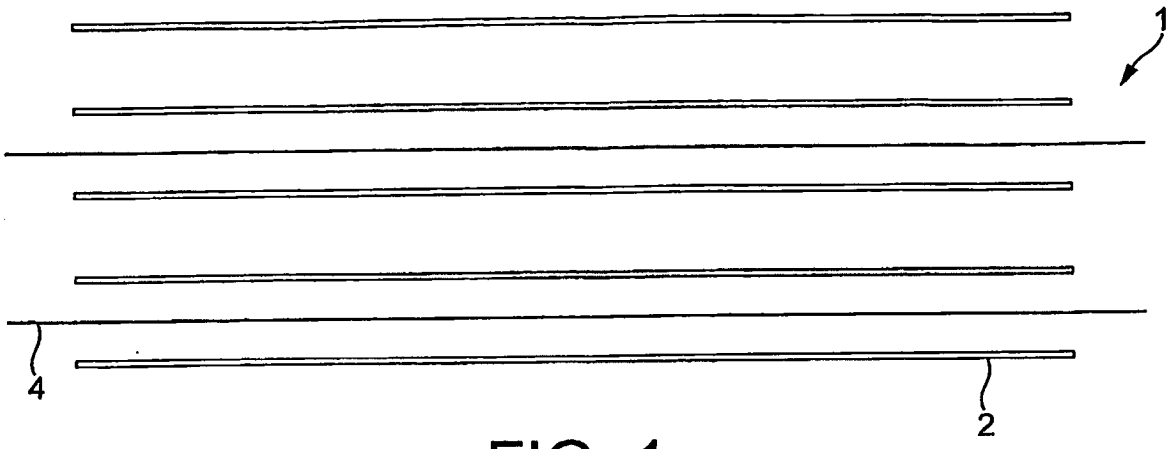


FIG. 1

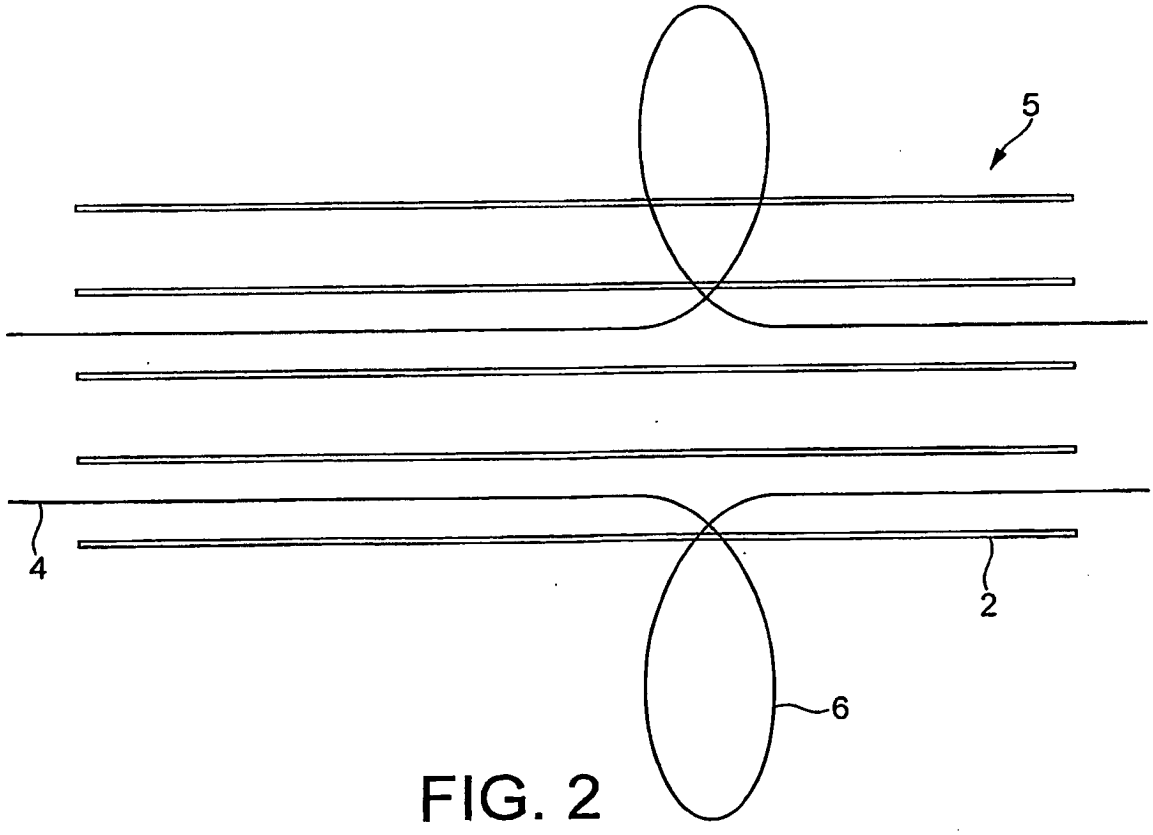


FIG. 2

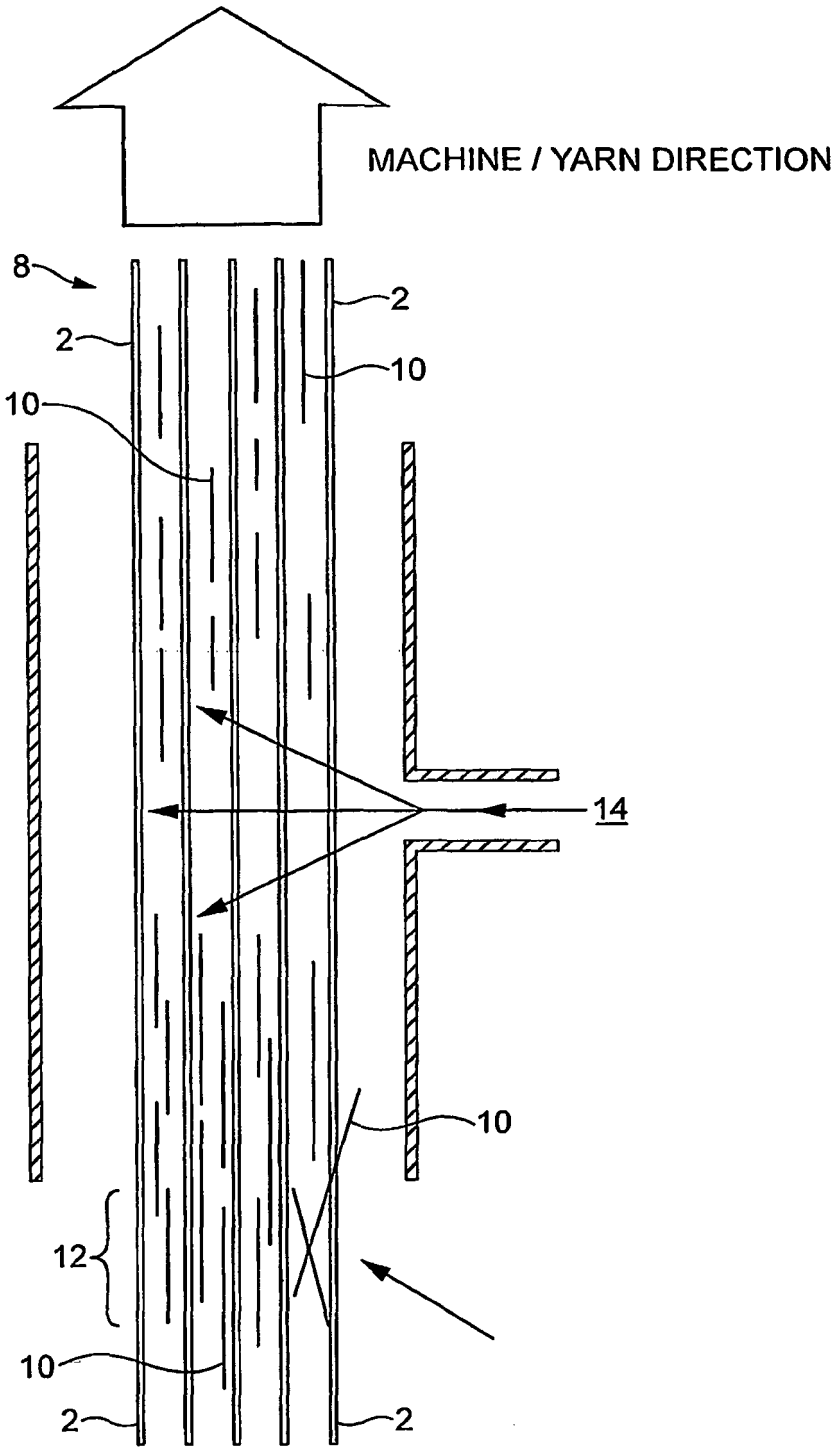


FIG. 3

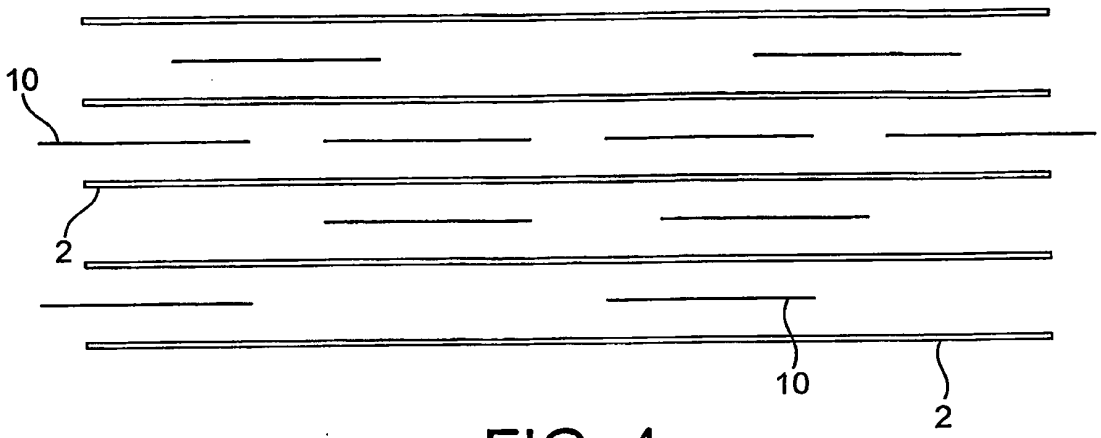


FIG. 4

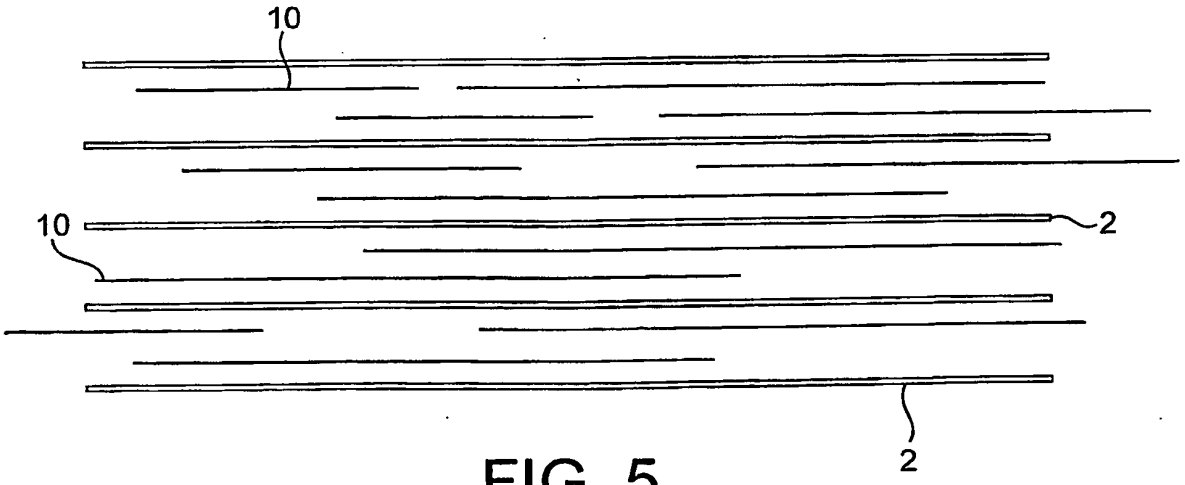


FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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